Instructions for Operation and Maintenance

"ROCKWELL" HARDNESS TESTER

Models JR and JS

DB-44

WILSON

MECHANICAL INSTRUMENT CO., INC.

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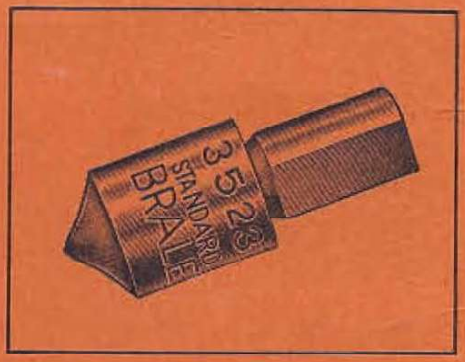
An Associate Company of American Chain & Cable Company, Inc.



"BRALE" PENETRATOR Sphero-conical diamond penetrator for testing hard steel. Illustration twice actual size. Do not chip diamond by hitting when inserting work. Ultimately breaks after extensive service. Must then be replaced by another of our standardized "BRALE" Penetrators ground to micrometric precision under enormous magnification, else accuracy of machine is lost. (Special "N BRALE" Penetrator required for "Superficial" type of "ROCKWELL" Tester.) Always keep a spare "BRALE" Penetrator for checking old one and for replacement.

BRALE is our Registered Trade Mark for these diamond penetrators.

"ROCKWELL" Test block of hardened and ground steel, or rectangular test block of brass, depending on hardness of material being inspected, must frequently be used as the only practical field method of determining condition of the tester in its entirety. At the very least, the tester should be checked against blocks every day and also whenever penetrator is inserted into position. Spare penetrator and spare dial gauge help to locate trouble if machine is out of condition.

ROCKWELL is our Registered Trade Mark for Test Blocks.

The sphero-conical diamond penetrator used on the Superficial Tester is named the N "BRALE" Penetrator. This is not a part of the regular equipment of the Tester, but is a separate attachment. It is used for testing hard materials such as hardened steel, nitrided steel, tungsten carbide or other similar hard alloys.

Be sure that the diamond penetrator used in your "Superficial" model of the "Rockwell" Hardness Tester is marked "N" before the word "BRALE" on the metal shank because penetrators marked "BRALE" without having the letter "N" are for use in the ordinary "Rockwell" Tester and are not suitable for use in the "Superficial" machine.

After having any of the penetrators out and replacing them, or after putting a new steel ball in the chuck, go through the operations of making a test on a piece of metal to set the chuck properly against the plunger before taking observed readings. Repeat this operation two or three times to seat the chuck firmly.

SELECTING LOAD — Superficial Tester

The weights for the "Rockwell" Superficial Hardness Tester consist of a weight pan which, when hung on the end of the power level, applies a major load of 15 kilograms. In addition to this there are two weights, each of which applies a major load of 15 kilograms. With this combination, major loads of 15, 30 or 45 kilograms can be used.

The load of 30 kg. is recommended for general use. The load of 45 kg. can be used if greater sensitivity is required, provided the metal is of sufficient thickness (or, if case hardened or nitrided steel is being tested, the hardened case is of sufficient thickness).

The load of 15 kg. is not recommended if the heavier load of 30 kg. can be used, but it should be used on sheet metal that is too thin for the 30 kg. or for nitrided steel with a very thin case.

In testing sheet metal, where it is questionable as to which load should be used, examine the underside of the sheet after making a test. If the impression of the penetrator can be seen then the reading is in error and a lighter load should be used.

SCALES — Normal Tester

The symbol for use as a prefix to the value read from the dial depends upon the load, type of penetrator and scale from which dial readings are taken, and these symbols are shown below.

Scale Symbol	Penetrator	Load in Kilograms	Dial Figures
B	**1/16" ball**	**100 kg.**	**Red**
C	**"BRALE"**	**150 kg.**	**Black**
A	"BRALE"	60 kg.	Black
D	"BRALE"	100 kg.	Black
E	1/8" ball	100 kg.	Red
F	1/16" ball	60 kg.	Red
G	1/16" ball	150 kg.	Red
H	1/8" ball	60 kg.	Red
K	1/8" ball	150 kg.	Red
L	1/4" ball	60 kg.	Red
M	1/4" ball	100 kg.	Red
P	1/4" ball	150 kg.	Red
R	1/2" ball	60 kg.	Red
S	1/2" ball	100 kg.	Red
V	1/2" ball	150 kg.	Red

SCALES—Superficial Tester

The symbol for use as a prefix to the value read from the dial depends upon the load, type of penetrator and scale from which dial readings are taken, and these symbols are shown below.

Scale Symbol	Penetrator	Load in Kilograms
15N	**"BRALE"**	**15 kg.**
30N	**"BRALE"**	**30 kg.**
45N	**"BRALE"**	**45 kg.**
15T	**1/16" ball**	**15 kg.**
30T	**1/16" ball**	**30 kg.**
45T	**1/16" ball**	**45 kg.**
15W	1/8" ball	15 kg.
30W	1/8" ball	30 kg.
45W	1/8" ball	45 kg.
15X	1/4" ball	15 kg.
30X	1/4" ball	30 kg.
45X	1/4" ball	45 kg.
15Y	1/2" ball	15 kg.
30Y	1/2" ball	30 kg.
45Y	1/2" ball	45 kg.

LIMITATIONS OF PENETRATORS

The Diamond "BRALE" Penetrators are intended for hard material only, that is material harder than B-100.

(If you have our "Superficial" machine with major loads of 15 kg., 30 kg., and 45 kg., which is a special machine for testing metal too thin to test on the normal machine, then do not use the steel ball for material harder than 15T-93 or 30T-82 or 45T-72 which are all of the same hardness as B-100.)

The range of the 1/16" diameter ball penetrator is from B-100 to B-0. If the ball is used to test material harder than about B-100 there is danger of flattening the ball. Also, because of its shape, the ball is not as sensitive as the cone to differences of hardness on hard samples, where the depth of impression is very slight. If the 1/16" ball is used on material softer than B-0, there is the danger that the cap of the penetrator, which holds the ball in place, will be resting on the sample, or that the power lever will descend too far and be resting on its stop pin. Furthermore, below B-0 the 1/16" ball becomes geometrically supersensitive and the readings erratic because errors and effects of inhomogeneity become unduly magnified.

If the hardness of the sample is below B-0, when using the 1/16" ball and 100-kg. load, then one of the larger ball penetrators or a lighter load should be used. We recommend using the smallest ball that can properly be used to make the test because of the loss of sensitivity as the size of the penetrator is increased. An exception to this is, when testing soft material which is not homogeneous, it may be preferable to use a large ball and thus obtain an average hardness.

For metals softer than C-20 use the 1/16" ball and 100-kg. load.

For metals harder than B-100 use the "BRALE" Penetrator and 150-kg. load.

For metals softer than B-0 use 1/16" ball and 60-kg. load or 1/8" ball and 100-kg. load.

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15W	1/8" ball	15 kg.
30W	1/8" ball	30 kg.
45W	1/8" ball	45 kg.
15X	1/4" ball	15 kg.
30X	1/4" ball	30 kg.
45X	1/4" ball	45 kg.
15Y	1/2" ball	15 kg.
30Y	1/2" ball	30 kg.
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The range of the 1/16" diameter ball penetrator is from B-100 to B-0. If the ball is used to test material harder than about B-100 there is danger of flattening the ball. Also, because of its shape, the ball is not as sensitive as the cone to differences of hardness on hard samples, where the depth of impression is very slight. If the 1/16" ball is used on material softer than B-0, there is the danger that the cap of the penetrator, which holds the ball in place, will be resting on the sample, or that the power lever will descend too far and be resting on its stop pin. Furthermore, below B-0 the 1/16" ball becomes geometrically supersensitive and the readings erratic because errors and effects of inhomogeneity become unduly magnified.

If the hardness of the sample is below B-0, when using the 1/16" ball and 100-kg. load, then one of the larger ball penetrators or a lighter load should be used. We recommend using the smallest ball that can properly be used to make the test because of the loss of sensitivity as the size of the penetrator is increased. An exception to this is, when testing soft material which is not homogeneous, it may be preferable to use a large ball and thus obtain an average hardness.

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Above it is said that the range of the 1/16" ball penetrator is from B-100 to B-0. It is necessary to emphasize and amplify this because several investigators have pub-

lished results of experimental work in which "ROCKWELL" tests have been made on material harder than B-100, in which they have used steel ball penetrators of 1/16" and 1/8" diameter, obtaining readings up to B-110 or B-120. Such readings are not "ROCKWELL" Hardness because all "ROCKWELL" scales stop at 100.

When the 1/16" ball is used on material above B-100 with the 100-kg. load there is a danger of flattening the ball; when it is used on material around B-115 and 120 this danger becomes a certainty, but this flattening is only the lesser of two of the reasons why the ball penetrator must not be used beyond the limits of its range; the principal reason against this misuse of the "ROCKWELL" is because of the loss of sensitivity which is introduced due to the geometry of the matter. With shallow penetration there are only small differences of depth in relation to large differences in diameter with a spherical penetrator. The "ROCKWELL" test is based entirely on depth measurements and only ignorance of its principle can account for anyone using it where ball impressions are so shallow as to give readings above B-100.

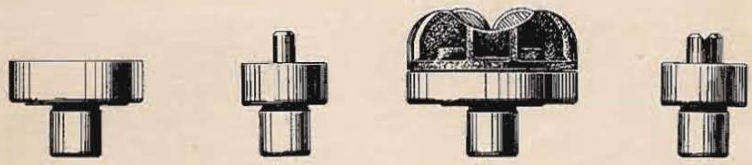
Some investigators have attempted to overcome the flattening of the 1/16" ball when used on hard material by using a 1/8" ball penetrator which of course is less liable to flattening since the applied load is spread over a greater bearing surface, but in using this larger ball on hard material there is even a greater loss of sensitivity on hard material than with the 1/16" ball. No matter what diameter of ball penetrator is used, no "ROCKWELL" readings should ever be taken above B-100 on the dial.

There would be excuse for using the steel ball penetrators on hard materials if there were no alternative, but a good and proper alternative has been provided in the Diamond "BRALE" Penetrator which with the greater load of 150-kg. must be used on material harder than B-100, in order to obtain a hardness reading free from error, of the maximum sensitivity, and a true "ROCKWELL" test that has not been perverted by a freak use of penetrators.

The portion of the B scale from B-0 to B-30 is intended for use only with soft material reading less hard than B-30, and it is not there for use with hard material running to above B-100.

ANVILS

There are four anvils supplied with each tester.



PLANE SPOT CYLINDRON JR. SHALLOW V

Plane This anvil with flat surface should be used in testing flat-bottom pieces of heavy section.

Spot This anvil with small elevated flat should be used for small pieces, thin pieces or any having bottoms not truly flat, sinee it is very important that contact is made between the piece being tested and that part of the anvil immediately beneath the penetrator. In testing pieces that are not flat, they should be placed on the anvil with the more convex side down, to make better contact with the anvil at the point of test, but never rest cylindrical surfaces on the SPOT anvil.

Cylindron Jr. This is an anvil with hard, parallel, twin cylinders and is used to support cylindrical pieces from 1/4" diameter up to 3" diameter.

Shallow V This is an anvil with a V groove and is used for round pieces that are too small in diameter to be supported properly on the CYLINDRON, Jr. anvil.

A round piece should never be supported on its cylindrical surface by a flat anvil, because of the danger of its slipping out when the major load is applied, and the risk of breaking the penetrator. An exception to this is where other means are provided which prevent lateral shift of the wire.

In addition to the aforementioned anvils, we can supply the CYLINDRON, which is similar to the CYLINDRON Jr., but is larger and is used to support pieces from 2" up to 8" diameter, if the work is several inches in length axially, or up to 5" to 6" diameter, if the axial length is very short.

Diamond spot anvil This is an anvil similar to the SPOT anvil, but having a diamond set into the spot and ground and polished to a flat surface. This is used only with the Superficial Tester and then only in conjunction with the steel ball penetrator for testing soft sheet metal. This anvil, when so used, does not become indented as is the case when using the steel spot anvil.

In addition to the anvils which we can supply, many users make special anvils or supports for unusual shapes and sizes.

If you make any anvils, be sure they are ground flat and true on their undersurfaces, or shoulders, where they rest upon the top of the elevating screw. The stem that enters the hole in the top of the elevating screw must not fit so tightly as to prevent seating all the way around at the shoulder, and that stem must be ground at a true right angle to the flat bearing surface mentioned.

Care should be taken before placing any anvil in the elevating screw to see that the undersurface is clean as well as the top of the elevating screw.

When changing anvils, run the elevating screw to a low position and remove the anvil very carefully so as not to hit the penetrator with the anvil. A few blows from the hardened anvil, or even a single blow, will do more damage to the penetrator than hundreds of tests on hardened steel. It is recommended that, in removing anvils from the elevating screw, one finger be placed across the top of the anvil to form a protection between the anvil and the penetrator.

Caution for testing sheet metal that is thin and soft Tests on such material should be made with the Superficial Tester, using the diamond spot anvil and steel ball penetrator. If, however, it is not possible to use this combination of Superficial Tester and diamond spot anvil, then the test must be made on the steel spot anvil, but repeated tests will indent the anvil in time and this indentation will cause an error in the readings. Therefore, the surface of the spot anvil should be watched and, whenever neeessary, should be relapped. Relapping should be done without rounding the edges of the spot. This top surface must be kept flat. For this purpose, we can supply a special lapping jig for keeping the anvil flat while lapping; this is a round plate with three holes to fit the shank of the anvil. The anvil to be lapped is placed in one hole while the other two are fitted with dummy anvils to form a three-point support.

OIL DASH POT

Warning If the tester is used without oil in the dash pot, the diamond penetrator, if being used, will be broken.

The speed at which the major load is applied is controlled by an oil dash pot.

The oil is removed from the dash pot for shipment and, before making a test, it should be filled to within about ¾" from the top of the pot with cold test motor oil such as Mobiloil Arctic Special Grade 10-10 W. This should be an early step in the assembly of the tester.

To fill the dash pot, which is inside the pedestal casting, remove both doors for access and light. The crank handle on the side of the tester should be turned counterclockwise as far as it will go. Unscrew and lift thc cap of the dash pot so that oil can be inserted.

Observe when oil is visible in dash pot and then pump crank handle back and forth, so working oil down past piston, and continue till it is certain the pot is full of oil up to about ¾" from the top.

It is recommended that, under conditions of extreme cold, if the dash pot cannot be adjusted to work quickly enough, shock absorber oil shall be substituted for the regular oil.

A further regulation of the speed of the dash pot, which controls the speed of the application of the weight, can be obtained by using a very light oil to increase, and a heavy oil to decrease, the speed. This change of oil should be necessary only under extreme conditions, where the machinc is used in low or high temperatures.

There is a knurled speed adjustment knob on the side of the dash pot. The speed at which the dash pot operates can be varied by rotating this knob one way or the other.

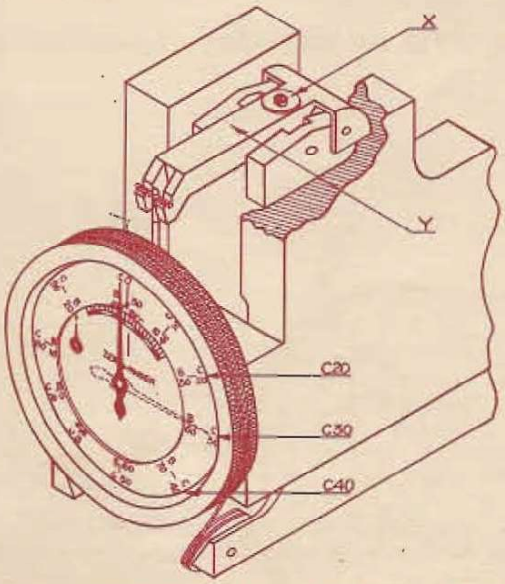
In adjusting the dash pot which controls the speed at which the load is applied, it should take 5 seconds after the crank handle has been tripped for it to complete its movement with the 100 kg. load in place and no work in the tester, or 4 seconds with the 150 kg. major load.

If the "ROCKWELL" Superficial Tester is being used, the speed should be 7 seconds with the 30 kg. load.

For production testing, where a large number of tests have to be made, the adjustment can be changed to operate at a faster speed especially when testing very hard pieces.

If a little oil should ooze out of the top of dash pot, it will do no harm, and indicates that it was a little too full.

INDEX LEVER ADJUSTMENT—Normal Tester



Sometimes, because of derangement through moving or shipping, the screw and knurled nut X in the index lever Y need adjustment. Sometimes the screw is turned when it should not be turned or adjusted.

To discover if adjustment of index lever screw X is needed: Put a piece of steel on the anvil and turn the capstan elevating nut to bring the steel piece up against the

ball penetrator and keep turning to elevate the piece until the hand feels positive resistance to further turning, which will be felt after the 10 kg. minor load has been picked up and when the major load is encountered; the pointer of the gauge should now be between C20 and C40, preferably close to C30. If it is not between C20 and C40, readjustment is necessary. Furthermore, since the pointer travels through several revolutions, it is important to note not only the position of the pointer but also to see that, when the major load is encountered, the pointer is also at the proper revolution which can be determined by the position of the small pointer which should be a little to the left of the dot (or equivalent to 11 o'clock). Then, when the piece of steel is lowered by turning the elevating nut so that the *long* pointer moves through 30 divisions, that is from C30 back to C zero, the small pointer should be vertical (equivalent to 12 o'clock) and in line with the dot; if it is not, it means that the adjustment is one or more revolutions in error and readjustment is necessary.

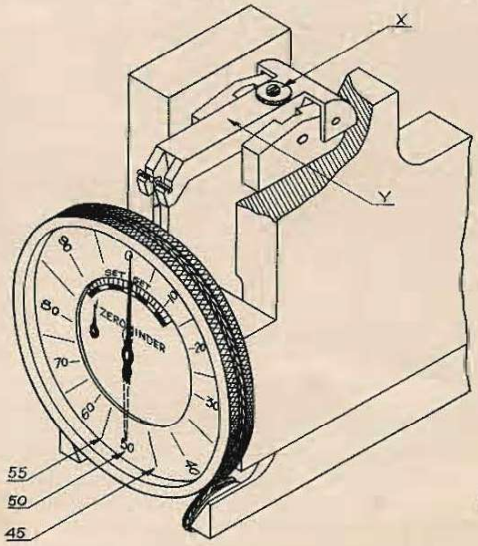
How to make the index lever adjustment

First, remove cowl, which is held in place by four screws, two in the front and two in the rear.

When the test piece is elevated till it starts to pick up the heavy load, loosen the knurled nut of the screw X. Then, using a small screw driver, turn the screw X bringing both pointers upright, the small pointer pointing to the dot and the *long* pointer in line with the vertical black line which is in the center of the upper half of the inside dial. Now turn the bezel, bringing the "set" arrow back of the *long* pointer. Then again turn screw X so that the *long* pointer moves to the right to C30. The small pointer will now be slightly to the left of the dot. Carefully holding the screw in its proper position with the screw driver, tighten the lock nut.

The object of the adjustment is to see that the elevation of the specimen to pick up the minor load shall not be carried too far, causing even partial application of the major load.

INDEX LEVER ADJUSTMENT — Superficial Tester



Sometimes, because of derangement through moving or shipping, the screw and knurled nut X in the index lever Y need adjustment. Sometimes the screw is turned when it should not be turned or adjusted.

To discover if adjustment of index lever screw X is needed: Put a piece of steel on the anvil and turn the capstan elevating nut to bring the steel piece up against the ball penetrator and keep turning to elevate the piece until the hand feels positive resistance to further turning which will be felt after the 3 kg. minor load has been picked up and when the major load is encountered; the pointer of the gauge should now be between 45 and 55, preferably close to 50. If it is not between 45 and 55, readjustment is necessary. Furthermore, since the pointer travels through several revolutions, it is important to note not only the position of the pointer but also to see that, when the major load is encountered, the pointer is also at the proper revolution which can be determined by the position of the small pointer which should be a little to the left of the dot (or equivalent to 11 o'clock). Then when the piece of steel is lowered by turning the elevating nut so that the long pointer moves through 50 divisions, that is from 50 back to zero, the small pointer should be vertical (equivalent to 12 o'clock) and in line with the dot; if it is not it means that the adjustment is one or more revolutions in error and readjustment is necessary.

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The object of the adjustment is to see that the elevation of the specimen to pick up the minor load shall not be carried too far, causing even partial application of the major load.

OPERATING INSTRUCTIONS IN DETAIL—Normal Tester

First, select the proper penetrating point (see "Penetrating Point, Selecting—Normal Tester") and insert it in bottom of plunger rod. See that weight for proper load is in position. Now place the proper anvil in the elevating screw (see "Anvils"). See that the undersurface of the piece to be tested, where it will rest upon the anvil, is free from any scale or burr that would flatten under test. Clean or file such away if present.

Place the piece to be tested on the anvil; then, by turning the handwheel, gently raise the piece until it comes in contact with the penetrating point. Continue turning the handwheel slowly until small pointer on the indicating gauge is nearly vertical and slightly to the right of the dot. Now watch only the *long* pointer on the gauge. Continue raising the work until the *long* pointer is approximately upright—within about five divisions plus or minus. You have now applied to the specimen a pressure of 10 kg., which is called the "minor load." Set the dial to zero (i.e., the line marked "set") by turning with the thumb the knurled ring located below the capstan handwheel.

This is always the starting point for all conditions of test, both for the "Brale" and steel ball penetrators, B zero is never used as the starting point of a test.

The setting of the dial to zero may be speeded up by use of the "Zerominder" device, which is fully explained under "Zerominder Device". Apply the major load by tapping downward on the bar which runs horizontally across the front of the machine below the knurled zero adjusting ring. This releases the weight arm and applies the major load uniformly to the penetrating point, forcing it into the material under test to a depth depending upon its hardness. The dial does not indicate

the hardness number while the major load is applied; the major load must be removed before taking the hardness number, and that is done by turning the crank handle, bringing it upward and forward.

The "ROCKWELL" reading is recorded as follows: If the test has been made with the 1/16" ball penetrator, and the load of 100 kilograms, the reading is taken from the red scale and the letter "B" is prefixed to the number to signify the condition of test.

If the test has been made with the "Brale" penetrator, and the load of 150 kilograms, the reading is taken from the black scale and the letter "C" is prefixed to the number.

If the tests are made with penetrators or loads different from the two standard tests described in the two preceding paragraphs, then the letter denoting the penetrator and load should be given. (See "Scales—Normal Tester.")

Having concluded the test, the handwheel is turned to lower the work, which is removed from the anvil, and the tester is in readiness for the next test.

OPERATING INSTRUCTIONS IN DETAIL—Superficial Tester

First select the proper penetrating point (see "Penetrating Point, Selecting—Superficial Tester) and insert it in bottom of plunger rod. See that weight for proper load is in position. Now place the proper anvil in the elevating screw (see directions on "Anvils"). See that the undersurface of the piece to be tested, where it will rest upon the anvil, is free from any scale or burr that would flatten under test. Clean or file such away if present.

Place the piece to be tested on the anvil; then, by turning the handwheel, gently raise the piece until it comes in contact with the penetrating point. Continue turning the handwheel slowly until small pointer on the indicating gauge is nearly vertical and slightly to the right of the dot. Now watch only the long pointer on the gauge. Continue raising the work until the long pointer is approximately upright—within about five divisions plus or minus. You have now applied to the specimen a pressure of 3 kg., which is called the "minor load." Set the dial to zero (i.e., the line marked "set") by turning with the thumb the knurled ring located below the capstan handwheel.

The setting of the dial to zero may be speeded up by use of the "Zerominder" device, which is fully explained under "Zerominder Device". Apply the major load by tapping downward on the bar which runs horizontally across the front of the machine below the knurled zero adjusting ring. This releases the weight arm and applies the major load uniformly to the penetrating point, forcing it into the material under test to a depth depending upon its hardness. The dial does not indicate the hardness number while the major load is applied; the major load must be removed before taking the hardness number, and that is done by turning the crank handle, bringing it upward and forward.

At this stage the reading of the "ROCKWELL" Superficial Hardness number is taken. If the test has been made with the 1/16" ball penetrator, then the reading is prefixed with the major load and the letter "T." (Example, 30T85.)

If the test has been made with the "N-BRALE" penetrator, then the reading is prefixed by the major load and the letter "N" (see plate affixed to front pillar of the Tester). (Example, 30N78.)

In addition to the "N" and "T" scale tests, other tests may be made with special scales designated as "W," "X" and "Y." As with the "N" and "T" scales, the "ROCKWELL" Superficial hardness number should be prefixed with the major load used while the letter indicates the penetrator used. (See "Scales—Superficial Tester.)

Having concluded the test, the handwheel is turned to lower the work, which is removed from the anvil, and the tester is in readiness for the next test.

Oiling Every two months remove the cowl from the testing head, remove the weights and weight pan, lift the power lever to disclose under its free end a hole in the top of the long vertical pusher rod that controls the lifting and lowering of the weights. Put a little oil in that hole.

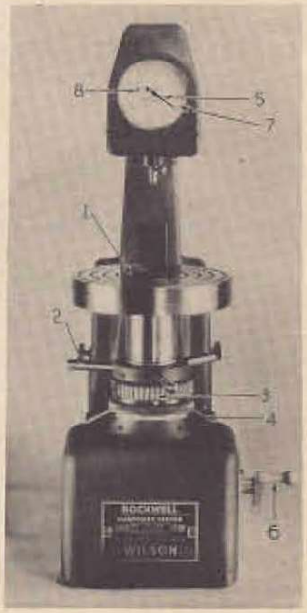
Once a week clean and oil the work elevating screw and the surface under the capstan nut.

Checking tester When making any important hardness tests be sure to check your tester on the master test blocks against which you know, by experience, your machine has checked in the past. By checking the tester, both before and after your important tests, you guard against errors due to damaged penetrators, use of wrong weight, bad adjustment of the tester due to some inexperienced person operating it, etc.

Level the "ROCKWELL" tester by the top surface of plane anvil. It needs to be only approximately level, but see that its seating is firm. It may be bolted to bench by bolts used in shipping it.

Operating and Control Mechanism The operating and control mechanism inside the pedestal and shown at the right may be removed in its entirety for repair or, if desired, a new mechanism may be quickly substituted for it as they are interchangeable.

OPERATING INSTRUCTIONS IN BRIEF



Usual and most precise method of operation Before starting test see that this crank handle is turned forward (counter clockwise) as far as it will go, thereby lifting weights.

1—Place specimen securely upon anvil or table.

2—Elevate specimen into contact with penetrator and further until small pointer (8) of the indicating gauge is nearly vertical and slightly to the right of the dot; then still further until large pointer points vertically upward.

3—Turn zero adjuster of gauge till the "Set" arrow on dial is exactly back of pointer.

4—Push down on depressor bar to apply major load.

5—Watch pointer till it comes to rest.

6—Pull crank handle forward, lifting major load, but leaving minor load still applied.

7—Read "ROCKWELL" Hardness Number.

Speedy method of operation, using the "Zerominder" supplementary scale for quantity inspection testing, is described under "Zerominder Device for Speedy Testing."

Place specimen on anvil or testing table so it is clear of the penetrator point, being careful not to hit penetrator. Good practice requires that piece to be tested shall not have dirt, heavy oil or scale underneath, where it rests upon the anvil. The anvil must be selected to suit size and shape of specimen.

Turn Capstan Nut to elevate specimen into contact with penetrator and continue turning and forcing penetrator upward till small hand on dial points approximately to dot and continue a bit further till large hand is approximately vertical. This will have applied the minor load.

Hand control of elevation of specimen by capstan wheel nut which causes specimen to press against and lift penetrator, thereby causing application of minor load. Thumb of same hand turns knurled ring to zeroize gauge. Same thumb depresses bar to release application of major load. The machine automatically controls speed of load application, after which the major load is removed by turning the crank handle at the side of tester, bringing it upward and forward, leaving hardness number indicated on scale of gauge.

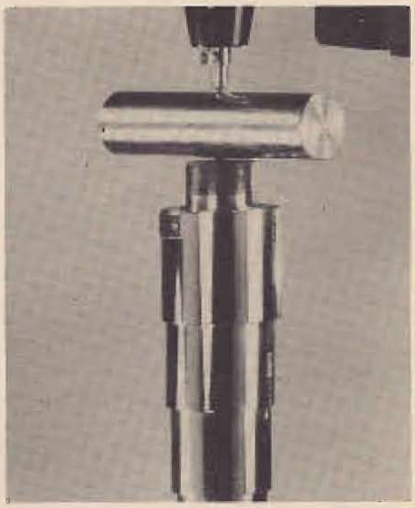
For tests of the most extreme accuracy the zeroizing of dial would be done leisurely before depressing the bar that operates major load system. On quantity inspection testing, to save time, the zeroizing of dial is done last, by means of the "Zerominder" device on the gauge, in a manner set forth under "Zerominder Device."

Right and Wrong Methods

Protect the "BRALE," or ball penetrator, with your finger when you remove an anvil, for hitting the hard but brittle diamond "BRALE" with hard anvil will break the "BRALE"—while hitting a steel ball penetrator will deform it.

Wrong method as "BRALE" or ball penetrator is hit in removing anvil or specimen due to not lowering the elevating screw enough. It is equally bad to hit the penetrator or drag work against it when inserting specimen.

Correct method of anvil support for cylindrical work which must rest in type of anvil that locates specimen centrally under penetrator and prevents movement of specimen under testing loads.



Wrong method of supporting cylindrical work on spot anvil, as no centering of round piece is secured and rolling of specimen may cause breakage of penetrator or erroneous readings.

Correct method of testing long, heavy work requires our Jack Rest or some improvised means to support the extended end of the piece to avoid any non-vertical pressure of specimen against penetrator. The Jack Rest should be adjusted so that a long piece being tested rests upon the "*Cylindron*" Anvil in the tester so that it is *parallel with the roll*ers and touching them throughout their length. This Jack Rest may be purchased as an accessory.

Wrong method of testing long work, causing injury to penetrator and, through leverage action, causing drag and jamming of plunger rod and inaccurate readings. Only short or light weight material may be permitted much overhang, for the specimen must be pressed rigid on the anvil by the pressure of the minor load which is applied as shown in a previous illustration. Jack Rest or Vari-Rest would correct this fault.

Medium overhang can best be taken care of with the adjustable Vari-Rest support, which rises and falls with the elevating screw. It is sold as an accessory. If you build any small rests, attach them carefully and firmly to the elevating screw—never to the anvil.

Massive pieces or pieces of such peculiar shape that they should rest in cradles or on blocks are best supported on this 8" diameter Testing Table, a favorite accessory for the toolroom. Wedges would permit the table to support some large, round parts.

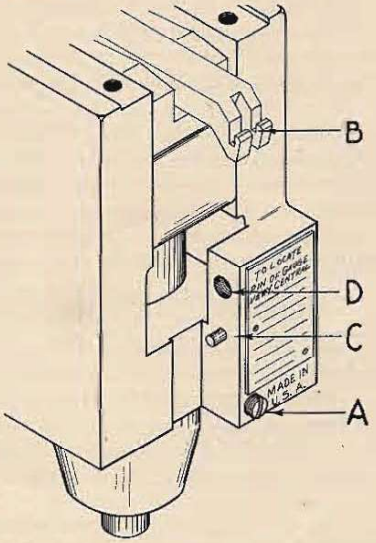
DIAL GAUGE

The dial gauge used on the "ROCKWELL" Direct Reading Hardness Tester is a micrometer gauge which measures, with scale reversed, the depth of indentation which is made in the sample under test when the load is applied to the penetrating point.

The dial gauge should not be oiled. If any trouble is suspected in the gauge, it should be removed from the tester (see below) and the stem raised with the finger. If it does not fall back freely—that is, if there is any sign of stem sticking—the gauge should be returned for repairs. Ship it to us at 383 Concord Ave., New York 54, N. Y.

It should be emphasized that, in handling the dial gauge, the greatest care must be exercised, as the stem is easily bent, which will cause it to bind, and if in applying the gauge to the tester it is necessary to tilt it to prevent the cross pin binding in the slot of the index lever, the gauge should be grasped by its body and not by its stem.

If the gauge must be removed, take off the head cowl by removing four screws, two at the back of the top of the cowl and two at the lower part of the front; loosen the clamp screw at the top of the gauge bezel and slip the cable over the top of the gauge. Then remove the gauge.



If the same gauge is being replaced on the tester, insert the cross-pin in the slot of the index lever, then the lug at the back of dial gauge is brought into position, easing it over the dowel pin C which projects from the head of the tester so that this dowel pin slips into the smaller of the two holes in the gauge lug. This allows the lug to come flush against the machined surface of the tester. Now into hole D insert the screw with its washer and tighten it, at the same time holding the dial gauge so that the lower part of the back of the gauge case is in contact with the head of positioning stop screw A.

If a new dial gauge is used, then it will probably be necessary to readjust this stop screw A. To do this, the gauge must be taken off the tester and the screw turned in or out until, when the gauge is replaced with the case touching the head of the screw and the small pointer is brought up to the dot on the dial, the cross pin is exactly central in the slot when sighted from the side.

A change of dial gauge will also necessitate a readjustment of the "Index Lever Adjustment". (See "Index Lever Adjustment".)

Replace the cable in the manner in which it was removed and tighten the clamp

screw at the top of the gauge bezel. Remove the doors on the side of the tester, and see that the cable has not come off the pulleys located at the lower part of the main frame casting. If it should be necessary to adjust the tension on the cable, remove capstan nut and small cowl together with depressor bar system back of handwheel. Under this cowl is an adjustment serew for regulating the cable tension.

It is necessary to adjust the ealibrated movable scale of the dial gauge so that the "Set" arrow moves the same amount to the right and left of the eenter of the stationary "Zerominder" markings. To do this, turn with your thumb the knurled zero adjusting ring, under the capstan nut, as far as possible to the right; loosen the clamp screw in the top of the bezel and turn the bezel until the "Set" arrow is over the last space on the left side of the "Zerominder" markings. Re-tighten elamp screw.

The stationary "Zerominder" markings on gauge are for use in speed testing by "Zerominder" method described under "Zerominder Device".

The dial of the gauge is provided with two graduations, one printed in black figures and the other in red. The black figured scale is used whenever the Diamond "BRALE" Penetrator is used in making the test, while the red figured scale is used whenever the test is made with a steel ball penetrator, no matter what its size.

The reason that the "Set" point of the red figured scale is at 30 instead of at 0 is to avoid readings below zero on soft brass, which would require a negative symbol and cause confusion. One revolution of pointer = .008" indentation.

One revolution of the large pointer represents movement of the penetrator of 0.1 mm. (.004").

The hardness scale designations of the "ROCKWELL" Superficial Hardness Tester will be found on the plate affixed to the front pillar.

The dial gauge has been tested for accuracy through one revolution and tests should not be made in which the depth of penetration exceeds one revolution of the pointer; if it does, the load should be changed to a lighter one or changed from the "N" "BRALE" to the ball penetrator to bring the penetration within one revolution.

"ROCKWELL" TEST BLOCKS

If we could make a "ROCKWELL" Hardness Tester in form as simple as a "ROCKWELL" Test Block that is the way we would make it. We cannot do that and so we build you a machine which has, and must have, many parts. Its parts can get worn, broken, dirty or be put out of adjustment, just as any sort of maehine can; and a *measuring* machine, especially one measuring micrometric values, is in one important way very different from a machine to do *work*. A measuring machine loses not some but all merit when not in fine condition.

Many "ROCKWELL" Testers have been in service many years, yet receive little or no checking. These old machines, their penetrators and gauges, used by successive operators on thousands or millions of tests, cannot all be in good condition. Even new machines should be checked frequently to make certain that they are in good order.

While it is impossible to give you a simple thing with which to measure hardness of your product we can give you the simplicity of a carefully made test block to check your "ROCKWELL" Tester. Don't be careless, or a gambler in your hardness testing, when there are ways provided for precision testing. Test blocks are cheap,—and cheaper still when ordered three or more at a time. The operation of the "ROCKWELL" is so simple that it is often entrusted to those who have had so little experience in measurement that they do not realize the need for checking. Someone should assume or be assigned that responsibility in each plant. We make the "ROCKWELL" with care and precision. We see that it reaches you in good order. After that the responsibility to ascertain that the machine is in shape for precision testing rests with you, and the test block puts the accuracy of our standardizing laboratory at your service.

Remember that if the gauge or penetrator or some other part of your machine is in bad order you are *not* making a genuine "ROCKWELL" Test.

DIAL ZEROIZING CABLE

If it is neccssary to insert new cable, remove the head cowl by removing four screws, two at the back of the top of the cowl and two at the lower part of the front. Remove the capstan nut and the cowl covering the cables located at the base of the machine behind the bezel control unit and release the cable tension by turning the screw locatcd betwcen the cables.

Loosen the small clamp screw on the top of the gauge bezel, slip the cable over the bezel and out of the grooves in the two pulleys located beneath the gauge. Remove the bracket holding these two pulleys. Then remove the buttons located in the sides near the top of the main casting which are there simply to fill two peepholes. Turn the machine on its back and remove the weight control mechanism to which the Oil Dash Pot is attached; this is accomplished by removing the crank handle, then the two doors, one on either side of the main casting; then three Allen cap screws, one at the front and two in the rear of the mechanism. Release the small screw holding the clamp which holds the cable to the zero adjuster. Rcmove the three small screws which fasten the finger grips to the zcro adjuster. The old cablc can now bc pulled out of the casting.

Slip the new cable at middle of its length under the washcr on top of the dial bezel, then tightcn the clamp screw, thus holding the cable in the groove of the bezel. Keeping the wire straight feed the ends through the two holes in the front of the machine. Look through the pecpholes and make sure the wire is running through the grooves in the pulleys. Reach through the bottom of thc machine and pull the wire through the next set of pulleys, being careful not to kink the wire. Put the ends of the wire through the two holes in the front of the machine and bring the wires around thc groove in the zero adjuster. Clamp the cable lightly. Replace the bracket with the two pulleys and slip the cable in the pulley grooves. Holding the free ends of the cable, pull the cable tight and clamp securely. Cut off the excess wire.

Replace the weight control mechanism and the crank handle; bring the tcster back to the upright position. Replace the finger grips on the zero adjuster.

Arrange the limited rotation of the knurled zero-adjusting ring, under thc capstan nut, with proper relation to "Set" arrow on thc dial gaugc as explained under "Dial Gauge". Adjust the tension plate by tightening the screw located on the bottom of the main frame casting. Replace hcad cowl, cowl covering cables, and handwheel.

CORRECTING TROUBLE

Test Blocks which have been marked from readings made on our Standard Testers may be purchased from us, and the Tester should bc periodically tested by means of these blocks; particularly if it is suspected that thc Tester is not reading correctly, reecurse should be made at once to the calibrated blocks. (Do not use a tcst block which has had the old impressions ground off. Such a block will probably be uneven in hardness; also there is no certainty that tbe new surface will be the same hardness as the original surface.) These tests will indicate whether the trouble is with the penetrator or the Tester; if, for instance, correct readings are shown on a soft block with ball but incorrect on a hard block with diamond, it would indicate that the trouble is with the diamond penetrator, but if incorrect readings are shown on both hard and soft blocks, that would indicate trouble in the tester and not with the penetrators.

If the various suggestions which follow fail to locate the cause, and to cure the trouble, then a letter should be written to us, giving in detail as fully as possible, an account of thc trouble that exists, quoting figures when possiblc. This will enable us to suggest possible rcmedies and pcrhaps prevent the necessity of returning the Tester to the factory.

Speed of test — too slow or too fast

The correct speed recommended at which to apply the major load is from four to five seconds; for production testing, where speed is important, this time may be slightly less, but it must be recognized that when the speed reaches two seconds or faster there is a sudden drop on the penetrating point instead of a gradual application of the load; this causes a deeper penetration, and if the diamond penetrator is being used, great danger of breaking it.

The speed is controlled by the oil dash pot, and this speed can be regulated according to directions.

If, in filling the dash pot, too much oil has been used, it will force itself out as tests are made; while, if there is a sudden drop at the start of the stroke, it is because there is not enough oil in the dash pot. The proper amount is within about ¾" from the top of the pot.

If, when applying the minor load, the small pointer of the indicating gauge cannot be brought to a vertically upright position

First look to the handle at the right of the machine and see that it is in its forward position; remove head cowl. Look to the top of the dial gauge stem and see that the small cross-pin does not bind in the slot of the index lever, which operates the Dial Gauge. If there is a binding, which is determined by lifting the index lever and allowing it to drop back into position, the screw which holds the gauge in place should be loosened and the gauge re-adjusted according to 6th paragraph, under "Dial Gauge". Then tighten the screw, making allowance for the fact that this tightening will tilt the gauge forward. If, after checking over the aforementioned points, the small pointer of the gauge still cannot be brought vertically upright, then it will be necessary to turn the adjusting screw in the index lever, as explained under "Index Lever Adjustment".

If low readings are obtained

This may be due to a broken diamond penetrator. The "Brale" penetrator should be removed from the tester and the point examined with a magnifying glass. If it is broken, it should be returned for replacement. If there is any doubt as to whether or not it is broken, return it to us for our examination.

If the tester, while the load is on, is subjected to vibration, too deep penetration and low reading will result.

Low readings may be caused by anything which would throw the penetrator or anvil out of perpendicular in its relation to the tester; that is, any dirt or metal chips or any foreign matter which comes between the seating of the anvil and the top of the elevating screw or between the shoulder of the penetrator and the lower face of the plunger.

Dirt or loose scale between the piece tested and the anvil would probably compress under application of the major load and give a low reading.

See that the fit of the anvil into the elevating screw is not too close a fit. It should be sufficiently loose so that when the anvil is lifted it will fall back into place without being forced.

The fit of the penetrator in the hole of the plunger should be such that it can be inserted and removed without undue force.

Friction in the head of the tester usually causes high readings through the prevention of the full application of the load, but it may sometimes cause low readings when it acts in such a way that it prevents the pointer of the gauge coming back to its proper position after the major load has been applied and released. To cure this it is necessary to clean the head parts, as described under "Cleaning Head Parts".

If high readings are obtained

First look to the penetrating point; if the $\frac{1}{16}$" ball is being used it may have beeome flattened; remove the chuck from the testcr, unscrew the cap, place a new ball on the stem and

replace the cap (extra balls are supplied with the machine, and a further supply can be purchased in lots of 100). If the "BRALE" penetrator is being used, remove it from the machine and examine the point with a magnifying glass—if it is broken it should be returned for replacement. If the trouble is not with the penetrating points, then the high readings may be eaused by a fault in the adjustment of the index lever screw (see "Index Lever Adjustment"), for if in applying the minor load, the major load is encountered or nearly encountered, a high reading results. High readings may also be caused by the introduction of friction in some of the working parts, either dirt or rust, and the head of the tester should be cleaned as described under "Cleaning Head Parts".

If the readings are non-uniform This is probably due to non-uniformity in the piecc being tested and before deciding that the machine itself is at fault, tests should be made upon thc standard tcst blocks supplied with the machine. It is important that the underside of the test piece, when it comes in contact with the anvil, be free from dirt, grit, loose scale or any projections which would flatten out as the major load is applied. If any such burrs or small projections do exist and if, for any reason, it is not practicable or desirablc to remove them by smoothing the under surfaee, then a preliminary test should be made with a small block placed between the penetrating point and the work and the regular load applied. Then the block may be removed and the test made in the usual way. Care should be taken before placing any anvil in the elevating screw to see that the undersurface is clean as well as the top surface of the elevating screw.

If the dial gauge is at fault That is, if, when the stem is raised with the finger, it does not return freely, but binds or sticks it should be removed from the machine and returned to us at 383 Concord Ave., New York 54, N. Y., for repairs. Sometimes the wrong load is employed so make sure the correct penetrator and load are in place. Also remember that no matter what penetrator and load are used, after the minor load is applied, you must zeroize the long pointer.

ELEVATING SCREW UNIT

The work elevating serew has telescopic sleeve covering which may be lifted for oiling the part of the screw above the capstan nut. About once a week the portion of this screw at and somewhat below the capstan nut should also be cleaned and oiled.

The sub-sleeve, which covers the part of the elevating screw that is below the machine, has the simple, single purpose of dust protection.

Keep the elevating screw lubricated with "Eel-Skid" oil. Also oil the bearing of the capstan nut handwheel hub where it rests and works upon the hardeped steel sleeve. It is well to lift the screw and wheel to reach this surface for oiling, but be sure to first remove anvil from the elevating screw, the penetrator from the plunger rod and the penetrator clamp screw. Otherwise, in lifting the screw, the anvil is certain to hit the penetrator and, if the diamond is being used, it will be broken and the anvil indented and spoiled.

See that the top surface of the elevating screw as well as the undersurface of the anvil is kept clean. Do not allow dirt or chips to become embedded in this top surface, for this will prevent a proper seating of thc anvil and cause crroneous rcadings.

Sometimes, the elevating screw receives an aecidental blow, forming a burr on one of the threads. Then, when the screw is lowered so that this burr engages in the handwheel or enters the hardened sleeve, the screw binds. To correct this, the burr should be carefully removed with a fine filc, but be sure to use the file *only on the spot* where it is needed. Do not place the screw in a lathe and file, grind or emery paper the whole circumference, for that will reduce the diameter of the screw at that point and cause excessive play between the screw and sleeve, which is detrimental to good results.